Marine Physical Laboratory

Multi-Scale Studies of Seafloor Topography

Fred N. Spiess

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Abstract

An important aspect of this program is provision of surface ship hull mounted echo sounding data in the Pacific Natural Laboratory area for comparison with the deeply towed system output. The seagoing portion of this element was carried out in July, 1993, by Dr. Peter Lonsdale using the SeaBeam 2000 system installed in **R/V Melville**. Initial data reduction was carried out at sea and data are available for eventual statistical comparisons and analyses.

Project Objectives

With the primary objective of obtaining deep sea floor topographic data similar to that delivered by ship mounted systems, but at finer scales, we have embarked on construction of a multi-beam swath mapper that can be operated as part of our Deep Tow system (Spiess and Lonsdale, "Deep Tow Rise Crest Exploration Techniques", Mar. Tech. Soc. J., Vol 16, pp.67-74, 1982). With this new system and **Melville's** SeaBeam 2000 we will, within the scope of this project, gather topographic data at a variety of scales in a representative portion of the sea floor. Two additional, closely related results should emerge from this work; a more powerful system for general use in studying the sea floor, and an analysis of signal processing methods to improve the resolution of swath mapping systems of all types.

Our plan is to build a deeply towed swath mapping sounding system with a number of beams and individual beam angular resolution comparable to those of hull mounted systems. The SeaBeam 2000 would have a footprint area of about 10,000 sq. m at the 3,000 m depth at the Natural Laboratory site. By operating the Deep Tow system at 500 m and 50 m off bottom we would have resolution areas of 300 sq. m and 3 sq. m respectively. These three data sets should thus provide material for critical tests of currently popular statistical representation approaches over a range of nearly four orders of magnitude.

Project Results

The area of major activity is completion of the swath mapping system itself, and integration of it with the other aspects of the deep tow system. At the outset we decided to use a single, fan-shaped transmitting beam and a line array of 44 small receiving elements, much in the style of the ship mounted systems. Given that we will not be pushing for operation more than 500 m off-bottom, it is possible for us to use a much higher frequency (100 kHz) than the hull mounted systems, and thus smaller transducer dimensions to achieve the desired 2 degree individual beam widths. We also decided early on to transmit the individual received signals up the wire (typically 9 km of conventional 0.68" electromechanical cable) and do the beamforming topside. This complicates the telemetry problem, but provides much greater flexibility, both in signal processing and in looking at other aspects of the returning energy. Fast Fourier Transform beamforming is being used, rather than time delays, taking advantage of the narrow band nature of the system. This approach, in principle, provides outputs from a large number of overlapping beams - our decision is to record 61 outputs, spaced approximately one degree apart, to cover the usable 60 degree aperture.

At the present time hardware aspects have been essentially completed and system debugging and software developments are proceeding. A first sea test in June 1992, revealed a number of problems, primarily related to telemetry and interactions among the various sonar systems (multi-beam, side looking sonar, transponder navigation, bottom penetration and obstacle avoidance sonars). These are currently being worked on with the goal of testing the system on two short test trips out of San Diego early in 1994.

This project is continuing with funds from another ONR grant.

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